

WHAT IS CLAIMED IS:

- 1 1. A method for electrically stressing through a specified voltage at least one
2 semiconductor chip on a wafer for controlled contactless burn-in, voltage screen and
3 reliability evaluation of product wafers, said method comprising:
4 applying said voltage to said at least one chip for the probing thereof in
5 the absence of physically contacting the chip surface; and
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7 magnetically inducing said voltage to said at least one chip through the
8 interposition of a mask onto which the voltage is induced and thereafter
9 conducted to electrical contacts on said wafer.
- 1 2. A method as claimed in Claim 1, wherein said applied voltage produces
2 specified voltage bias conditions by inducing the voltage for a circuit utilizing a time
3 varying magnetic field which is fixed with respect to said circuit.
- 1 3. A method as claimed in Claim 2, wherein an electrical field which is
2 represented by said induced voltage is based on Faraday's law setting forth that said
3 voltage which is induced by a time rate of change of a magnetic field for said circuit
4 which is fixed with respect to said magnetic field.
- 1 4. A method as claimed in Claim 1, wherein said induced voltage is obtained at a
2 top layer of said mask which is positioned on said wafer; and connections are made to
3 said at least one chip by said mask for effectuating said burn-in without interference
4 with the normal operation of said at least one semiconductor chip.
- 1 5. A method as claimed in Claim 2, wherein said circuit comprises a loop
2 defining an area on a wafer, said mask being positioned on said wafer so as to enclose
3 said area and having electrical contacts for an induced voltage through said time
4 varying magnetic field within said enclosed area.

1 6. A method as claimed in Claim 5, wherein said loop comprises a metallic line
2 on said wafer forming an open circuit having electrical contact points provided at open
3 ends of said circuit for producing said induced voltage.

1 7. A method as claimed in Claim 6, wherein said loop is of a rectangular
2 configuration to define a generally rectangular area on said wafer.

1 8. A method as claimed in Claim 6, wherein said metallic line is constituted of
2 copper.

1 9. A method as claimed in Claim 6, wherein said metallic line is constituted of
2 aluminum.

1 10. A method as claimed in Claim 2, wherein said circuit comprises a circular
2 magnetic core having an air gap for receiving said wafer with said at least one chip
3 and said mask positioned thereon; and an electrical coil for energizing said magnetic
4 core to produce said specified voltage bias conditions.

1 11. A method as claimed in Claim 10, wherein said voltage is supplied to said
2 electrical energizing coil from a radio frequency voltage source.

1 12. A method as claimed in Claim 11, wherein said circular magnetic core is
2 constituted of a Permalloy powder having a composition 2% by weight of *Mo*, 81% by
3 weight of *Ni* with the remainder being iron and impurities.

1 13. A method as claimed in Claim 10, wherein said air gap receiving said wafer
2 and mask is adapted to provide for the burn-in of differently sized wafers.

1 14. A method as claimed in Claim 10, wherein said electrical energizing coil
2 consists of an isolated electrical wire comprised of copper wire strands.

1 15. A method as claimed in Claim 10, wherein said wafer and mask are retained in
2 said air gap by a wafer holder consisting of a dielectric material.

1 16. A method as claimed in Claim 10, wherein said magnetic core includes a
2 plurality of said circular magnetic cores interconnected by arms, and each said core
3 having an air gap for receiving respectively a wafer and covering mask so as to
4 facilitate the simultaneous controlled burn-in of a plurality of said wafers.

1 17. A method as claimed in Claim 2, wherein a rectangular core of non-magnetic
2 material has electrical wire coils wound thereabout, said wire coils being connected to
3 decal masks on a plurality of wafers positioned centrally on said core, each said decal
4 mask being provided to conduct a generated voltage to a chip under said mask.

1 18. A method as claimed in Claim 17, wherein each said coil is conducted to a
2 time varying voltage source so as to generate a magnetic field perpendicular to the
3 surface of each said wafer in the center of said non-magnetic core.

1 19. A method as claimed in Claim 18, wherein electrical wires extend from each
2 said mask to a panel for the direct measurements and verification of the direct voltages
3 present on each of said wafer.

1 20. A method as claimed in Claim 17, wherein said non-magnetic core is
2 constituted of wood.

1 21. A method as claimed in Claim 17, wherein at least nine wafers are positioned
2 on each core for simultaneous burn-in thereof.

1 22. A method as claimed in Claim 1, wherein said mask comprises an interposer
2 forming a decal on said wafer surface so as to protect the surface of said wafer from

3 direct contact with a probe during burn-in and voltage screening through electrical
4 stressing.

1 23. A method as claimed in Claim 22, wherein said method conducts the generated
2 burn-in voltage to said at least one chip when mountable on P+ silicon substrates.

1 24. A method as claimed in Claim 22, wherein said method conducts the generated
2 burn-in voltage to said at least one chip when mountable on P- silicon substrates.

1 25. A method as claimed in Claim 22, wherein said interposer is formed for
2 mounting the wafer on either P+ silicon or P- silicon substrates by the steps of:

3 fixing a polyimide film to a frame to fully cover said wafer;

4

5 depositing at least on layer of a metallic film onto the polyimide film;

6 patterning said metallic film to provide wiring lines extending to the
7 edge of said wafer to facilitate measuring the induced voltage;

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9 removing exposed metallic layer material at the bottom of the vias and
10 depositing a further wiring line layer forming a ring wire loop on said
11 wafer which is connected to said first wiring lines to facilitate applying
12 an electrical bias to each said ring wire loop;

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14 placing lead/tin bumps into each of said vias and connecting said
15 bumps to said further wiring lines; and

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17 adjusting bump heights whereby the pattern of the bumps interiorly of
18 the decal mask is a mirror-image of wire bond pads or C4 connects on
19 the wafer chip which is to be burned-in.

1 26. A system for electrically stressing through a specified voltage at least one
2 semiconductor chip on a wafer for controlled contactless burn-in, voltage screen and
3 reliability evaluation of product wafers, said system comprising:
4 an arrangement for applying said voltage to said at least one chip for
5 the probing thereof in the absence of physically contacting the chip
6 surface; and
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8 magnetically inducing said voltage to said at least one chip through the
9 interposition of a mask onto which the voltage is induced and thereafter
10 conducted to electrical contacts on said wafer.

1 27. A system as claimed in Claim 26, wherein said applied voltage produces
2 specified voltage bias conditions by inducing the voltage for a circuit utilizing a time
3 varying magnetic field which is fixed with respect to said circuit.

1 28. A system as claimed in Claim 27, wherein an electrical field which is
2 represented by said induced voltage is based on Faraday's law setting forth that said
3 voltage which is induced by a time rate of change of a magnetic field for said circuit
4 which is fixed with respect to said magnetic field.

1 29. A system as claimed in Claim 26, wherein said induced voltage is obtained at a
2 top layer of said mask which is positioned on said wafer; and connections are made to
3 said at least one chip by said mask for effectuating said burn-in without interference
4 with the normal operation of said at least one semiconductor chip.

1 30. A system as claimed in Claim 27, wherein said circuit comprises a loop
2 defining an area on a wafer, said mask being positioned on said wafer so as to enclose
3 said area and having electrical contacts for an induced voltage through said time
4 varying magnetic field within said enclosed area.

1 31. A system as claimed in Claim 30, wherein said loop comprises a metallic line
2 on said wafer forming an open circuit having electrical contact points provided at open
3 ends of said circuit for producing said induced voltage.

1 32. A system as claimed in Claim 31, wherein said loop is of a rectangular
2 configuration to define a generally rectangular area on said wafer.

1 33. A system as claimed in Claim 31, wherein said metallic line is constituted of
2 copper.

1 34. A system as claimed in Claim 31, wherein said metallic line is constituted of
2 aluminum.

1 35. A system as claimed in Claim 27, wherein said circuit comprises a circular
2 magnetic core having an air gap for receiving said wafer with said at least one chip
3 and said mask positioned thereon; and an electrical coil for energizing said magnetic
4 core to produce said specified voltage bias conditions.

1 36. A system as claimed in Claim 35, wherein said voltage is supplied to said
2 electrical energizing coil from a radio frequency voltage source.

1 37. A system as claimed in Claim 36, wherein said circular magnetic core is
2 constituted of a Permalloy powder having a composition 2% by weight of *Mo*, 81% by
3 weight of *Ni* with the remainder being iron and impurities.

1 38. A system as claimed in Claim 35, wherein said air gap receiving said wafer
2 and mask is adapted to provide for the burn-in of differently sized wafers.

1 39. A system as claimed in Claim 35, wherein said electrical energizing coil
2 consists of an isolated electrical wire comprised of copper wire strands.

1 40. A system as claimed in Claim 35, wherein said wafer and mask are retained in
2 said air gap by a wafer holder consisting of a dielectric material.

1 41. A system as claimed in Claim 35, wherein said magnetic core includes a
2 plurality of said circular magnetic cores interconnected by arms, and each said core
3 having an air gap for receiving respectively a wafer and covering mask so as to
4 facilitate the simultaneous controlled burn-in of a plurality of said wafers.

1 42. A system as claimed in Claim 27, wherein a rectangular core of non-magnetic
2 material has electrical wire coils wound thereabout, said wire coils being connected to
3 decal masks on a plurality of wafers positioned centrally on said core, each said decal
4 mask being provided to conduct a generated voltage to a chip under said mask.

1 43. A system as claimed in Claim 42, wherein each said coil is conducted to a time
2 varying voltage source so as to generate a magnetic field perpendicular to the surface
3 of each said wafer in the center of said non-magnetic core.

1 44. A system as claimed in Claim 43, wherein electrical wires extend from each
2 said mask to a panel for the direct measurements and verification of the direct voltages
3 present on each of said wafer.

1 45. A system as claimed in Claim 42, wherein said non-magnetic core is
2 constituted of wood.

1 46. A system as claimed in Claim 42, wherein at least nine wafers are positioned
2 on each core for simultaneous burn-in thereof.

1 47. A system as claimed in Claim 26, wherein said mask comprises an interposer
2 forming a decal on said wafer surface so as to protect the surface of said wafer from

3 direct contact with a probe during burn-in and voltage screening through electrical
4 stressing.

1 48. A system as claimed in Claim 47, wherein said method conducts the generated
2 burn-in voltage to said at least one chip when mountable on P+ silicon substrates.

1 49. A system as claimed in Claim 47, wherein said method conducts the generated
2 burn-in voltage to said at least one chip when mountable on P- silicon substrates.

1 50. A system as claimed in Claim 47, wherein said interposer is formed for
2 mounting the wafer on either P+ silicon or P- silicon substrates by means of:
3 fixing a polyimide film to a frame to fully cover said wafer;
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5 depositing at least on layer of a metallic film onto the polyimide film;
6 patterning said metallic film to provide wiring lines extending to the
7 edge of said wafer to facilitate measuring the induced voltage;
8
9 removing exposed metallic layer material at the bottom of the vias and
10 depositing a further wiring line layer forming a ring wire loop on said
11 wafer which is connected to said first wiring lines to facilitate applying
12 an electrical bias to each said ring wire loop;
13
14 placing lead/tin bumps into each of said vias and connecting said
15 bumps to said further wiring lines; and
16
17 adjusting bump heights whereby the pattern of the bumps interiorly of
18 the decal mask is a mirror-image of wire bond pads or C4 connects on
19 the wafer chip which is to be burned-in.